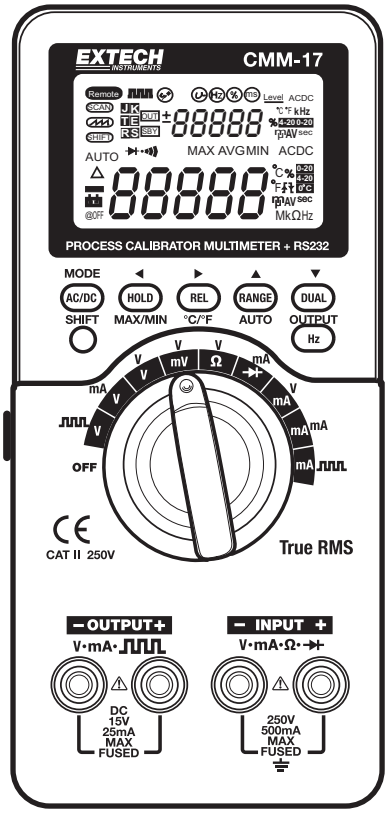
User's Guide

EXTECH INSTRUMENTS

Process Calibrator Multimeter

Model CMM-17



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■ *Warranty*

EXTECH INSTRUMENTS CORPORATION *warrants this instrument to be free of defects in parts and workmanship for three years from date of shipment (a six month limited warranty applies to sensors and cables). If it should become necessary to return the instrument for service during or beyond the warranty period, contact the Customer Service Department at (781) 890-7440 ext. 210 for authorization or visit our website* **www.extech.com** *for contact information. A Return Authorization (RA) number must be issued before any product is returned to Extech. The sender is responsible for shipping charges, freight, insurance and proper packaging to prevent damage in transit. This warranty does not apply to defects resulting from action of the user such as misuse, improper wiring, operation outside of specification, improper maintenance or repair, or unauthorized modification. Extech specifically disclaims any implied warranties or merchantability or fitness for a specific purpose and will not be liable for any direct, indirect, incidental or consequential damages. Extech's total liability is limited to repair or replacement of the product. The warranty set forth above is inclusive and no other warranty, whether written or oral, is expressed or implied.*

☎

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SAFETY INFORMATION

A **WARNING** identifies conditions and actions that may pose a hazard to the user; a **CAUTION** identifies conditions and actions that may damage this device.

Table 1 - International Electrical Symbols

	AC - Alternating Current
	DC - Direct Current
	AC and DC - Alternating and Direct Current
	Ground
	Double Insulation
	See Explanation In The Manual

☐ SAFETY INFORMATION

⚠ *Warnings and Cautions*

To avoid electric shock, injury, or damage to this instrument and ensure that you use the meter safely, follow the safety guidelines listed below:

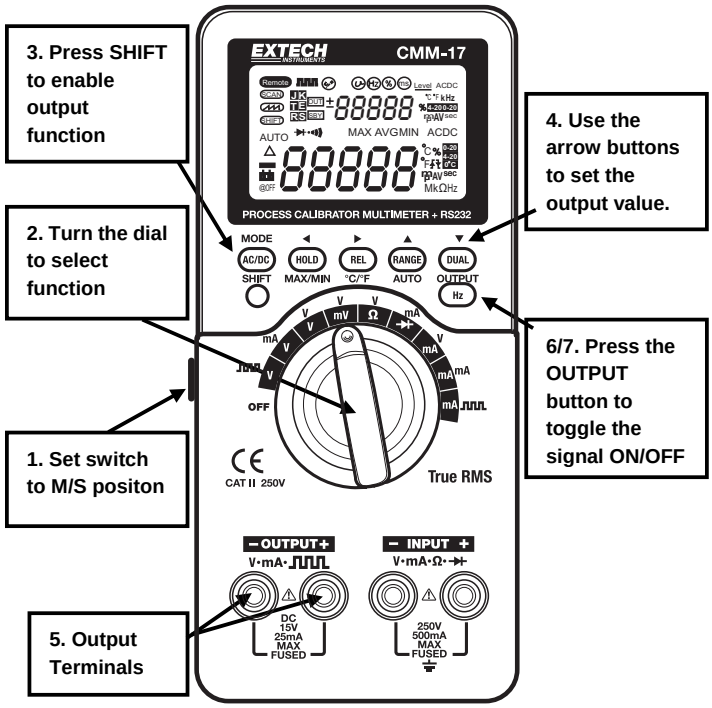
- Read this operation manual completely before using this device and follow all safety instructions.
- This device is for indoor use (altitude up to 2,000 m).
- Use the device only as specified in this manual; otherwise, the protection provided by the meter may be impaired.
- Never measure Voltage when the current measurement is selected.
- Do not use this device if it appears damaged.
- Inspect the leads for damaged insulation or exposed metal. Replace damaged leads.
- Disconnect the power and discharge all high-voltage capacitors before testing in the resistance, continuity, or diode modes.
- Use caution when working above 70V DC or 33VRMS and 46.7V peak, such voltages pose a shock hazard.
- Always keep your hands behind the protective guard of the probe while measuring.
- Select the proper function and disconnect the test leads from test points before changing functions.
- Do not mix battery types. Always use specified battery.
- The meter is safety-certified in compliance with EN61010 (IEC 1010-1, IEC 1010-2-031) Installation Category II 250V Pollution Degree 2. In order to maintain its insulation properties, please be sure to use compatible test probes.
- In an R.F field the supplied test leads will pick up induced noise. For better shielding, a short-twisted lead should be used.

⚠ WARNING
Read "SAFETY INFORMATION" before using this device.

■ *OUTPUT- Setup and output a process calibration signal*

1. Set the side switch to the **M/S** position
2. Turn the function switch to select a function combination for the output (⎍⎍, **mA**, or **V**) and input.
3. Press **"SHIFT"** to change the button operation to the output mode.
4. Use the **arrow** buttons (◄ / ► for digit selection, ▲ / ▼ for value) to set the output value.
5. Connect the **OUTPUT** terminals to the device to be tested.
6. Press the **OUTPUT** button. The process signal will become active.
7. Press the **OUTPUT** button again to stop the output.

Figure 1 Quick Output Operation

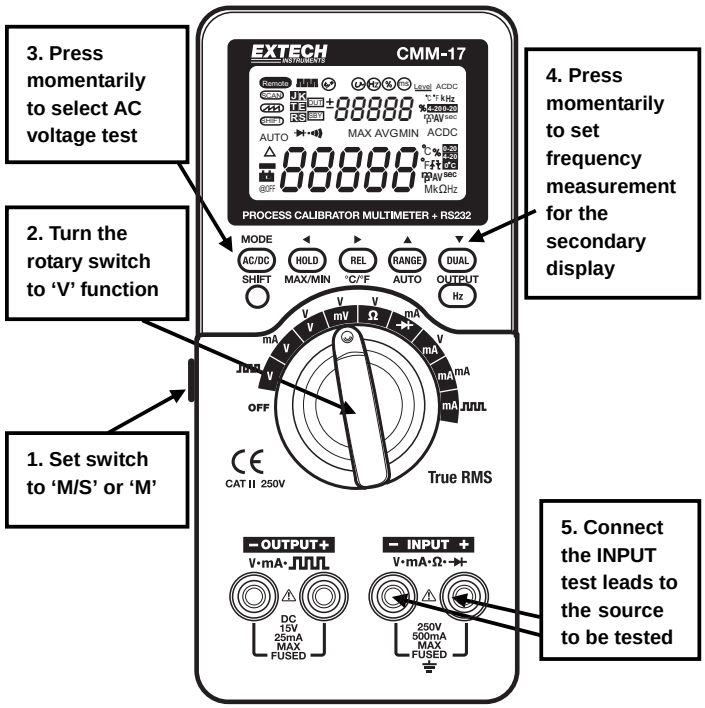


OUTPUT FUNCTIONS ARE CODED IN YELLOW
INPUT FUNCTIONS ARE CODED IN WHITE

■ *INPUT- ACV and Frequency measurements*

1. Set the switch on the left side of the meter to the **M** or **M/S** position
2. Turn the rotary switch to select "**V**" and the output function (⎍⎍⎍, **mA** or **V**) as desired.
3. Press the **"AC/DC"** button momentarily to select AC voltage measurement.
4. Press the "**Dual**" button momentarily to set frequency as the secondary display measurement.
5. Connect test leads from the **INPUT** terminals to the device under test.

Figure 2 Dual display of AC Voltage (ACV) and Frequency (Hz)



OUTPUT FUNCTIONS ARE CODED IN YELLOW
INPUT FUNCTIONS ARE CODED IN WHITE

■ *INTRODUCTION*

This CMM-17 process calibrator/meter is a hand-held, battery-operated instrument ideal for testing and troubleshooting electronic systems. In addition, this device can be used for maintaining, servicing industrial meters, testing electronic circuits and electronic equipment. This meter can also be used to measure or calibrate sensors or transmitters in automotive or automatic control systems.

The meter generates a high precision constant voltage, constant current and square wave output and includes a full featured, high accuracy multimeter. The precision source and the measurement functions can be used simultaneously.

Main Features:

- Generates and Measures signals simultaneously
- 1,200Ω drive capability with special yellow lead for 20mA simulation.
- High precision Constant voltage, Constant Current and Square wave outputs
- Intelligent Output and Standby control
- Built-in Ni-MH rechargeable battery
- Smart Charger design
- EL backlit display
- Coarse and Fine output adjustments
- % scale displays for 4-20mA or 0-20mA signals
- Adjustable step and interval values for Auto Scan
- Adjustable resolution and start time for linear Ramp output.
- 1ms Peak Hold in-rush voltage and current capture
- Temperature measurements with optional 0°C compensation
- Frequency, Duty cycle and Pulse width measurements.
- Dynamic Recording for MIN/MAX/AVG
- Data Hold with Manual or Auto Trigger
- Relative mode for offset and zero functionality
- Diode and Audible Continuity tests
- Bi-directional optical computer interface with SCPI commands
- Safe, precise, and quick calibration
- 50,000 count precision True-RMS digital multi-meter designed to meet IEC-1010 CAT. II 250V standards

■ *LCD Display Description*

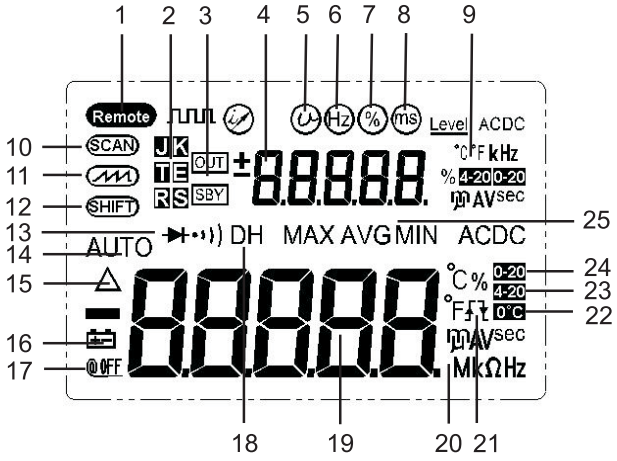


Figure-3 LCD Display

1. Remote control
2. Thermocouple type
3. Output enable/disable
4. Secondary display for output and input
5. Constant voltage output
6. Square wave output for Hz
7. Square wave output for %
8. Square wave output for mS
9. Output/input units
10. Scan output
11. Ramp output
12. Shift button operation
13. Diode/audible continuity
14. Auto range
15. Relative mode
16. Low battery
17. Auto power off icon
18. Data Hold (manual trigger)
19. Primary display for input
20. Input units
21. Positive/negative trigger slope for % and mS tests
22. Without ambient temperature compensation
23. % 4-20/4-20mA
24. % 0-20/0-20mA
25. Dynamic recording

■ *Slide Switch*

The power selector switch (left side of meter) can be set to the following positions:

- **Charge:** this position is selected to charge batteries. Use the DC adapter to charge the meter.
- **M:** Measurement-only function, output is disabled.
- **M/S:** Both source and measure functions can be used, simultaneously.

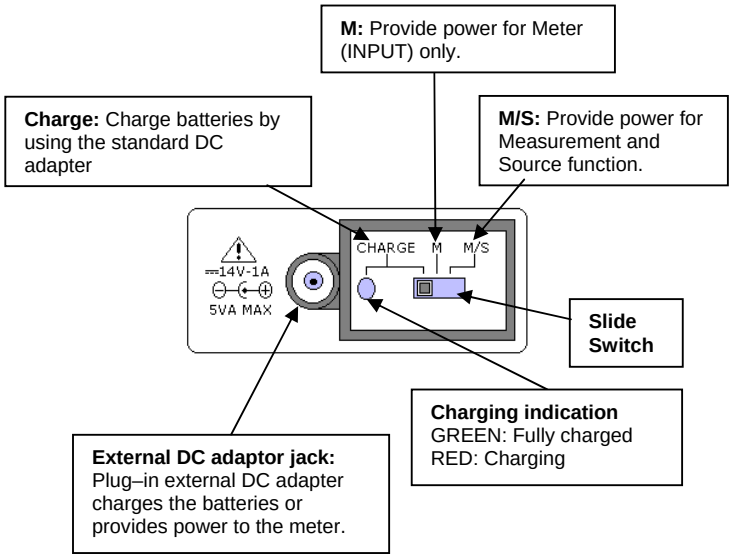

M: Provide power for Meter (INPUT) only.
Charge: Charge batteries by using the standard DC adapter
M/S: Provide power for Measurement and Source function.
CHARGE
M
M/S
14V-1A
5VA MAX
Slide Switch
Charging indication
GREEN: Fully charged
RED: Charging
External DC adaptor jack:
Plug–in external DC adapter charges the batteries or provides power to the meter.

Figure-4 Slide Switch

■ *Rotary Switch*

Set the slide switch to the **M** or **M/S** position. Turn the meter ON and select a function combination by turning the rotary switch (**Figure-5**). The output and input functions are selected together. The outside (yellow) row represents the **OUTPUT** (SOURCE); the inside (white) row represents the **INPUT** (METER) function.

FUNC.	INPUT (White Color)	OUTPUT (Yellow Color)
1	**Power Off**	
2	DC, AC or DC+AC Voltage measurements.	Square wave output ⎍⎍⎍
		Constant current : ± 25 mA
		Constant voltage : ± 1.5V, ± 15V
3	DC, AC or DC+AC mV measurements (Temperature)	Constant voltage : ± 1.5V, ± 15V
4	Resistance/ Continuity measurements	Constant voltage : ± 1.5V, ± 15V
5	Diode/ Audible Continuity.	Constant current : ± 25 mA
6	DC, AC or DC+AC mA measurements: 50mA and 500 mA	Constant voltage : ± 1.5V, ± 15V
		Constant current : ± 25 mA
		Square wave output ⎍⎍⎍

Set the slide switch to the M or M/S position. Turn the meter ON and select a function combination by turning the rotary switch.

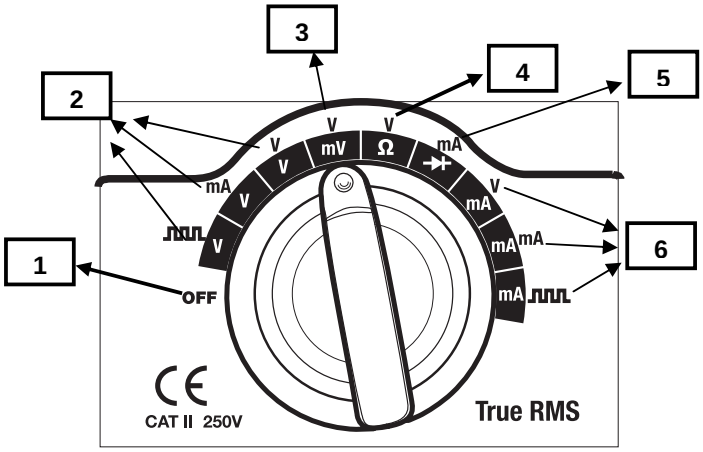


Figure-5 Select function combinations using Rotary Switch

■ *INPUT and OUTPUT TERMINALS*

⚠WARNING
To avoid damage to this device do not exceed the input limits.

This device has four terminals. Two terminals are used for input functions (with overload protection) and two terminals are used for the output functions. Overload protection is 30 volts DC (refer to the table below):

Table 2 Input limit specifications

ROTARY SWITCH FUNCTION	INPUT TERMINAL V Ω →|– mA	OVERLOAD PROTECTION
AC/DC Voltage range: 5V~ 250V	+ and -	250 V RMS
AC/DC Voltage range: 50mV~ 500mV		
Ohm (Ω)		
Diode (→|– •)))		
Temperature		
AC/DC Current range: 50 ~500mA		250V/630mA, quick acting fuse

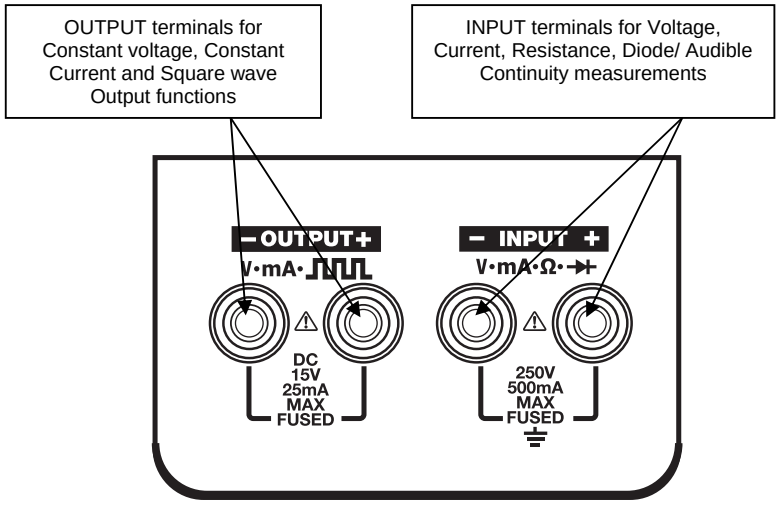

OUTPUT terminals for Constant voltage, Constant Current and Square wave Output functions
INPUT terminals for Voltage, Current, Resistance, Diode/ Audible Continuity measurements
– OUTPUT +
V•mA•
DC 15V 25mA MAX FUSED
– INPUT +
V•mA•Ω•→|–
250V 500mA MAX FUSED

Figure-6 Output and Input Terminals

PUSH-BUTTON OPERATION

Push-button operations are detailed below. When a push-button is pressed, a related display symbol will switch ON and the beeper will sound.

■ *INPUT OPERATIONS*

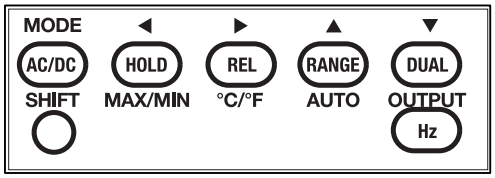


Figure-7
Control Buttons

1. AC/ DC (BLUE): Select DC, AC, DC+AC Test
- In Voltage mode, use this button to step through DC, AC and DC+AC.
- In Current mode, use this button to step through DC, % of mA, AC and DC+AC.
- For Voltage and current measurements, hold this button for more than 1 second to toggle 1 ms peak hold on/off. The display will show "**DH MAX**" to indicate PEAK + or "**DH MIN**" to indicate PEAK -.
- For Ohm tests, push this button momentarily to toggle continuity "•))) " on/off. The continuity beeper will sound when the measurement is below 10 ohms or 1000 counts.
- For Duty cycle and Pulse width tests, press and hold this button for more than 1 second to change the trigger slope to ⌐↑ or ¬↓.
- For temperature measurements, use this button to toggle the environment compensation ON/OFF. The 0°C sign means environmental compensation has been disabled.

2. HOLD: DATA HOLD (Trigger) or Refresh Data Hold (Auto trigger)
- Press this button momentarily to hold (freeze) the existing displayed digital value and to enter the trigger mode.
- Press this button momentarily again to trigger and update the data hold display
- Press and hold this button for at least one second to exit the DATA HOLD mode.
- In "Refresh Hold" mode (selected in the setup mode), the display updates automatically when the reading changes (an audible tone sounds when an update occurs).

3. HOLD (MAX • MIN): Dynamic Recording
- Record maximum, minimum, and calculate true average.
- Press this button for at least 1 second to toggle the recording mode on/off.
- Use this button to cycle through **MAX, MIN, AVG** and present readings.
- The beeper sounds when a new maximum or minimum value is recorded.
- Use this button to cycle through **Peak +**, **Peak -** after setting the peak mode. The screen displays "**DH MAX**" to indicate PEAK + and "**DH MIN**" to indicate PEAK -.

4. REL (ZERO): Relative function
- The relative function displays the difference between the measured value and the stored value.
- Press to store the displayed value and to toggle **Relative (Δ)** ON or OFF.
- Press and hold this button for at least 1 second to enter the Temperature (mV) measurement mode. Press and hold this button for at least 1 second to exit the temperature function.

5. RANGE:

- In auto-range mode: Press this button to select the Manual range mode (the "**AUTO**" display icon will switch off).
- In manual range mode: Press this button momentarily to step up 1 range at a time (press and hold for at least 1 second to select auto-range).
- In auto-range mode: "**AUTO**" icon is ON and the meter automatically selects the appropriate range for the measurement. If a reading is greater than the maximum available range, "OL"(overload) will be displayed. The meter will select a lower range when a reading is less than 9% of full scale.
- Push this button momentarily to change measuring range and re-start the PEAK+ and PEAK- measurements after setting the peak mode.

6. DUAL: Dual Display Combination

- Press this button momentarily to choose a display combination. For combination displays, please refer to the **MULTI-DISPLAY MULTIMETER** section.
- Push this button momentarily to re-start a new peak value measurement after setting peak mode.

7. Hz: Select Frequency, Duty Cycle and Pulse Width Tests

- For Voltage or Current tests, press this button momentarily to enter the Frequency test mode. Voltage or Current will be indicated in the secondary display. Press this button again to step through Frequency, Duty cycle, and Pulse width tests. Press and hold this button for at least one second to return to the voltage or current measurement mode.
- For available combination displays, please refer to the chapter **MULTI-DISPLAY MULTIMETER**.

8. : Back-light/SHIFT

- Press this button momentarily to shift the push-button operation. The push-buttons control output functions when the SHIFT (SHIFT) icon appears on the display.
- Press and hold this button for at least 1 second to toggle the backlight ON or OFF. Backlighting turns off automatically.

■ *OUTPUT OPERATION*

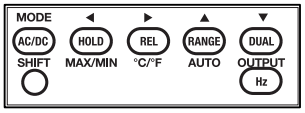


Figure-8
Control Buttons

1. (SHIFT): Backlit/SHIFT
- Press this button momentarily to shift the operation of the push buttons. All push buttons will be used to adjust OUTPUT states when SHIFT is on the display.

2. MODE: Select adjustment mode
- For the square wave output, press this button momentarily to select which parameter is to be adjusted. Press this button to cycle through **Hz, %, ms and amplitude** adjustment modes.
- For constant voltage output, press this button momentarily to cycle through **±1.5V, ±15V, SCAN ±1.5V, SCAN±15V, RAMP±1.5V** and **RAMP±15V** output modes.
- For constant current output, press this button momentarily to cycle through **±25mA, SCAN±25mA** and **RAMP±25mA** output modes.
- After setting SCAN and RAMP for constant voltage and current output, press and hold this button for at least 1 second to enter the Memory generation adjustment mode. Please refer to the Memory Generation section for a detailed description.

3. ◄ (LEFT): Select Digits or polarity to be adjusted
- For voltage and current outputs, press this button momentarily to move the adjustment position from polarity, digit 1, 2, 3, 4, 5 and back to polarity. The selected position will flash on the screen.

± ← Digit 5 ← Digit 4 ← Digit 3 ← Digit 2 ← Digit 1 ← ±

- After set SCAN mode for voltage and current output, press this button momentarily to select **Continuous**, **Cycle** or **Step** output. Normally, it is defined to continuous output. Please refer to the chapter about Memory Generation for detail description.
- After set RAMP mode for voltage and current output, press this button momentarily to select **Continuous** or **Cycle** output. Normally, it is defined to continuous output. Please refer to the chapter about Memory Generation for detail description.

4. ► (RIGHT): Select which Digits or polarity to be adjusted
- Press this button momentarily to move the adjustment position from polarity, digit 5, 4, 3, 2, 1 then scroll up to polarity. The selected position will be flashed on the screen.

± → Digit 5 → Digit 4 → Digit 3 → Digit 2 → Digit 1 → ±

5. ▲ (UP): Adjust digit or polarity
- Press this button momentarily to increase the selected digit by 1 count or toggle the polarity of the output.
- Press and hold this button to scroll quickly.

6. ▼ (DOWN): Adjust digit or polarity
- Press this button momentarily to decrease the selected digit by 1 count or toggle the polarity of the output.
- Press and hold this button to scroll quickly.

7. OUTPUT: Control the output state
- Press this button momentarily to toggle the output state **ON** and **OFF**. The OUT icon indicates a signal is being sourced. The SBY icon indicates the signal has been disabled (standby).
- For SCAN and RAMP adjustment modes, press this button momentarily to save a setting

POWER-ON OPTIONS

■ ***How to enter the setup mode***

Press and Hold the **MODE (BLUE)** button while turning the rotary switch to any "ON" position. The meter will enter the setup mode. These parameters will remain in non-volatile memory.

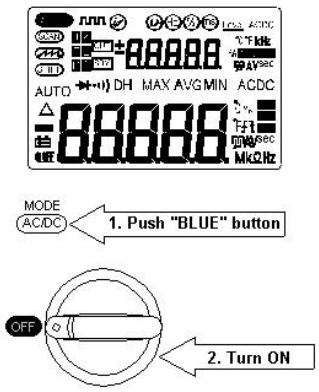


Figure-9 Power-ON Options

The user can configure the related parameters in the setup mode by following these steps:

1. Press the "◀ **(LEFT)**" or "▶ **(RIGHT)**" button to select the menu item to be set.
2. Press the "▲ **(UP)** or ▼ **(DOWN)**" button to change a parameter.
3. Press the "**OUTPUT**" button momentarily to save changes.
4. Press the "**SHIFT**" button momentarily to exit the setup mode.

■ *Factory Default*

Table-3 describes the setup menu items and indicates the default settings.

Table-3 Setup Menu Items

Menu item	Factory Setting	Selectable Parameters
Baud Rate	9600	2400, 4800, 9600, 19200
Parity	None	Odd, even or none
Data bits	8	8 bits or 7 bits (Stop bit = 1 bit)
ECHO	OFF	ON or OFF
Print	OFF	ON or OFF
Percentage scale	4-20mA	4-20mA and 0-20mA for % scale readout
Frequency	0.5Hz	Set minimum measurement frequency, 0.5Hz, 1Hz or 2 Hz.
Beep	4800	The tone frequency can be set to 4800, 2400, 1200 or 600 Hz. “OFF” means to disable beep.
Temperature * n1	°C	Four combinations can be selected: 1. °C only 2. °C/ °F 3. °F only 4. °F/ °C
Refresh Hold	OFF	OFF = Data Hold (Manual Trigger), set trigger from 100~1000 counts
Auto power off	15	1~99 minutes; “OFF” = disables auto power off.
Backlit	30	1~99 seconds; “0FF” = disables auto power off for backlight

Notes:

The temperature menu can be selected once the “SHIFT” icon is lit on the display. Press and hold the “**SHIFT**” button for at least one second to enable the temperature option, “SHIFT” will appear on the display.

■ *Baud Rate*

The baud rate can be set to 2400, 4800, 9600 or 19200.

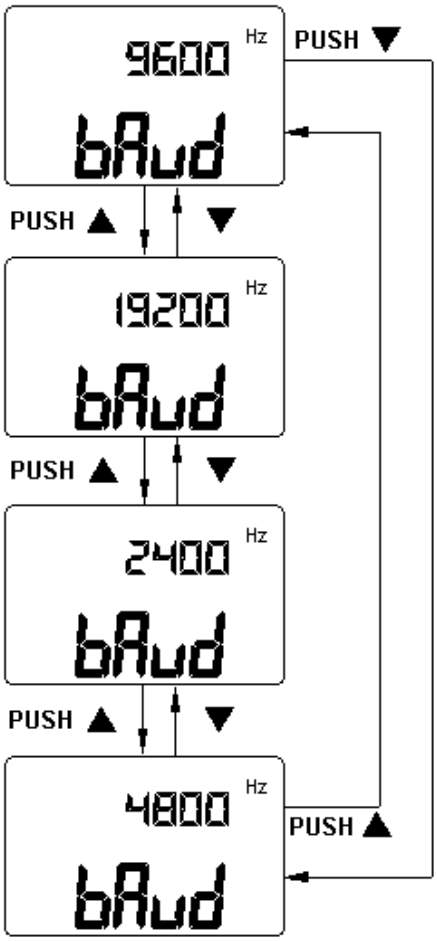


Figure-10 Baud rate setup for remote control

■ *Parity Check*

The parity check can be set to none, even or odd. To select the parity:

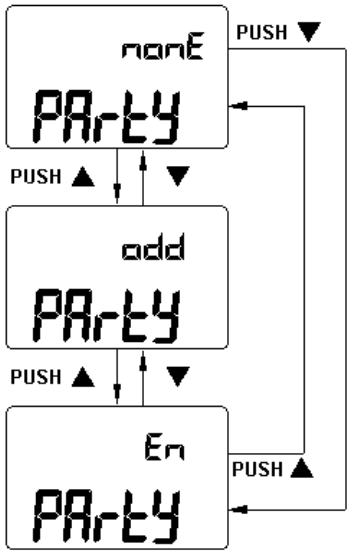


Figure-11 Parity Check setup for remote control

■ *Data Bits*

The data bits can be set to 8 or 7 bits. The stop bit is fixed (1 bit) and can not be changed.
Select the data bit as follows:

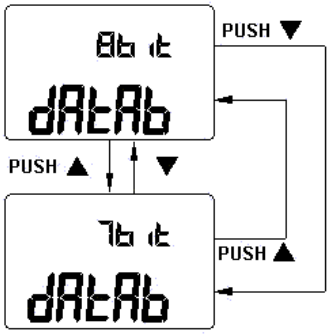


Figure-12 Data bit setup for remote control

■ *Echo*

With ECHO ON, the meter echoes (returns) all the characters it receives. Enable the Echo as follows:

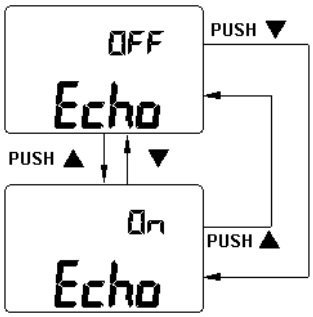


Figure-13 ECHO Setup

■ *Print only*

In the Print-only mode, the meter will print the measured data when the measuring cycle is completed. The meter automatically sends the newest data to a PC continuously. The meter does not accept any commands from the PC with Print-Only enabled. The meter's remote indicator flashes during operation when Print-only is ON. To enable print-only:

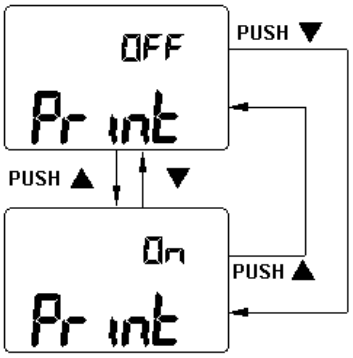


Figure-14 Print-only Setup

■ *Percentage (%) scale for 4-20mA or 0-20mA measurements*

In this mode, the DC current measurements are displayed using the % scale. 4-20mA or 0-20mA measurements are displayed as 0%~100%. For example, a 25% scale display represents 8mA for a 4-20mA signal, and 5mA for a 0-20mA signal. Set the % scale as follows:

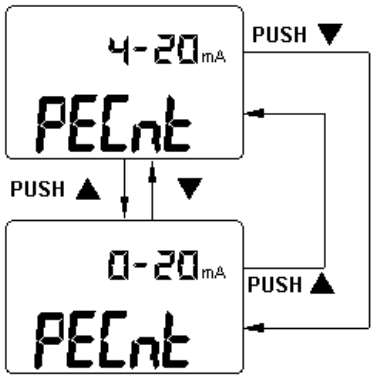


Figure-15 % scale Setup for mA measurements

■ *Minimum Frequency measuring*

The minimum measurement frequency influences the measurement rate for frequency, duty cycle, and pulse width measurement. Normally, the measurement rate defined in the specification chart is based on the minimum frequency of 1 Hz.

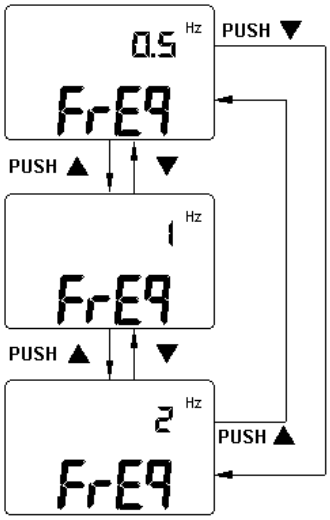


Figure-16 Minimum Frequency Setup

■ *Audible Tone Frequency*

The audible tone frequency can be set to 4800, 2400, 1200 or 600 Hz. The beeper can also be turned OFF for silent operation.

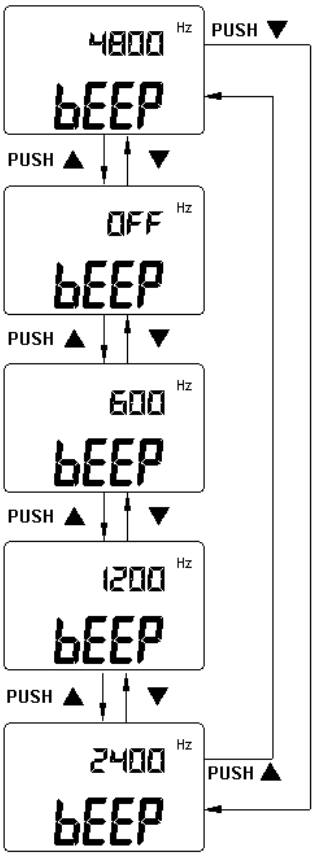


Figure-17 Beeper tone frequency

■ *Temperature Units*

1. Celsius only (°C on primary display only)
2. Celsius/ Fahrenheit (°C/ °F), the primary and secondary display can be switched to indicate Fahrenheit/ Celsius (°C/ °F).
3. Fahrenheit only (°F on primary display only)
4. Fahrenheit/ Celsius (°F/ °C), the primary and secondary display can be switched to indicate Celsius/ Fahrenheit (°F/ °C)

Press and hold SHIFT for at least one second to open the temperature scale menu

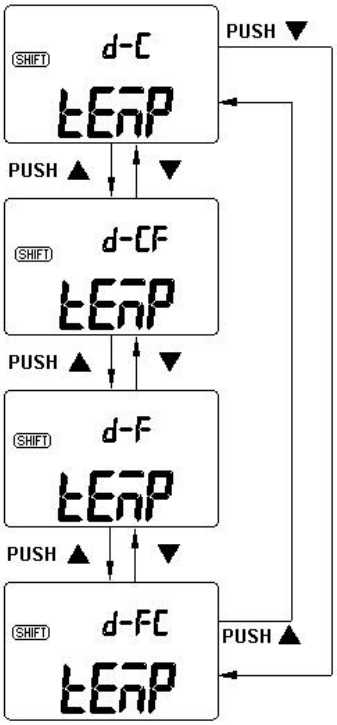
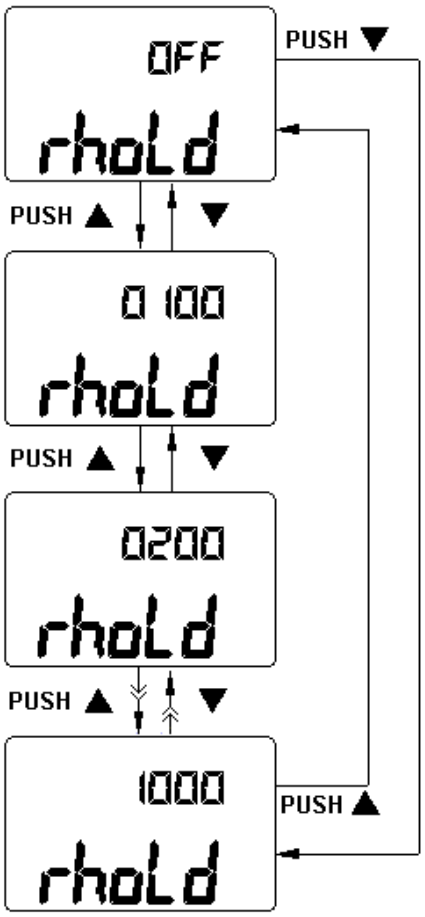


Figure-18 Temperature Unit Setup

■ *Data Hold/Refresh Hold*

The factory default setting for the Data Hold mode is MANUAL Trigger by key-press/ BUS Trigger by remote control. Set to “OFF” for Data Hold (Manual Trigger), and set from 100~1000 to enable Refresh Hold. When the measured value exceeds the setting (100~1000) the refresh hold will trigger. Enable Refresh Hold as follows:

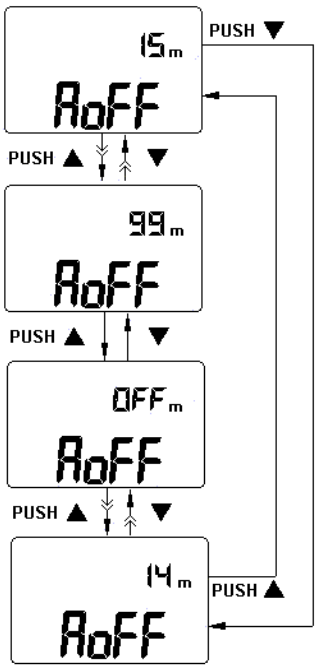
Figure-19 Data Hold/ Refresh Hold Setup



■ *Auto Power Off*

The timer for auto power off can be set from 1~99 minutes, “OFF” disables auto power off. Set the auto power off timer as follows:

Figure-20 Auto power off setup



The Auto power off feature was designed conserve battery energy. The instrument will automatically turn off at the programmed time unless one of the following actions occurs:

- A key is pressed
- The measurement function is changed
- The meter is set to datalog
- 1 ms peak hold is set
- Auto power off has been disabled
- The output has been enabled (the OUT is displayed)

The rotary switch must be set to the OFF position and then to an active position again to activate the meter after an auto power off action. When the meter is to be used for long periods of time, the operator may wish to disable the auto power off feature. The "AOFF" icon will switch off when the auto power off function is disabled.

■ *Backlit Display*

The backlight timer can be set from 1~99 seconds, a setting of “0FF” indicates that the backlight is disabled. The backlight automatically turns off after the programmed time. Set the time as follows:

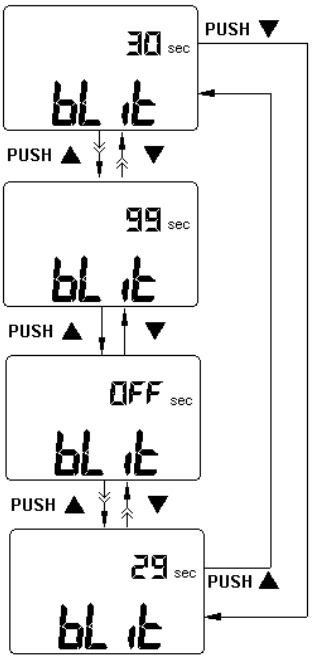


Figure- 21 Backlit Timer Setup

SCAN and RAMP Output Functions

For constant voltage and current outputs, this device employs two automatic and programmable output functions. The SCAN output mode offers 16 steps where each step can be programmed for amplitude and time interval. The RAMP output offers dual slopes for linear output simulation with an adjustable resolution. Refer to the information provided below for more detailed instructions on SCAN and RAMP output features:

■ *AUTO SCAN OUTPUT*

1. **Selecting the scan function**
2. Turn the rotary switch to the mA or V output position.
3. Press SHIFT button momentarily to shift the operation of the push buttons. Ensure that the SHIFT icon is on the display.
4. For voltage outputs, press the MODE button momentarily to cycle through **±1.5V, ±15V**, **SCAN±1.5V, SCAN±15V**, **RAMP±1.5 V** and **RAMP±15V** output modes.
5. For current outputs, press the MODE button momentarily to cycle through **±25mA**, **SCAN ±25mA** and **RAMP ±25mA** output modes.
6. After setting the scan function, the SCAN icon will switch on.

Table of initial memory settings:

Mode	SCAN ±1.5000 V		SCAN ±15.000 V		SCAN ±25.000 mA	
Step	**Amplitude**	**Time interval**	**Amplitude**	**Time interval**	**Amplitude**	**Time interval**
1	+1.5000 V	02 sec	+15.000 V	02 sec	+00.000 mA	02 sec
2	+1.2000 V	02 sec	+12.000 V	02 sec	+04.000 mA	02 sec
3	+0.9000 V	02 sec	+09.000 V	02 sec	+08.000 mA	02 sec
4	+0.6000 V	02 sec	+06.000 V	02 sec	+12.000 mA	02 sec
5	+0.3000 V	02 sec	+03.000 V	02 sec	+16.000 mA	02 sec
6	+0.0000 V	02 sec	+00.000 V	02 sec	+20.000 mA	02 sec
7	-0.3000 V	02 sec	-03.000 V	02 sec	+16.000 mA	02 sec
8	-0.6000 V	02 sec	-06.000 V	02 sec	+12.000 mA	02 sec
9	-0.9000 V	02 sec	-09.000 V	02 sec	+08.000 mA	02 sec
10	-1.2000 V	02 sec	-12.000 V	02 sec	+04.000 mA	02 sec
11	-1.5000 V	02 sec	-15.000 V	02 sec	+00.000 mA	02 sec
12	+0.0000 V	00 sec	+00.000 V	00 sec	+04.000 mA	00 sec
13	+0.0000 V	00 sec	+00.000 V	00 sec	+08.000 mA	00 sec
14	+0.0000 V	00 sec	+00.000 V	00 sec	+12.000 mA	00 sec
15	-1.5000 V	00 sec	-15.000 V	00 sec	+16.000 mA	00 sec
16	+0.0000 V	00 sec	+00.000 V	00 sec	+20.000 mA	00 sec

Automatic SCAN output

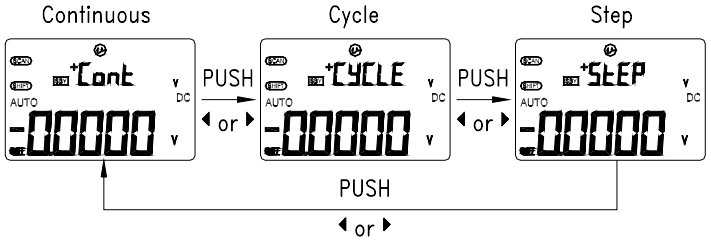
After selecting the SCAN function, press the "◀" or "▶" button momentarily to scroll through the three SCAN modes: Continuous, Cycle or Step output. The secondary display will show **Cont, CYCLE**, or **StEP** respectively.

In the Continuous and Cycle output modes always start from step 1. Note that if the time interval for step1 is set to 00 seconds, the step 1 amplitude will only output when the output function is activated. If you stop the output when in the continuous or cycle mode, the output will return to step 1.

1. **Cont:** (Continuous output). Press the "**OUTPUT**" button to start. The meter output signal will follow the programmed steps, starting from step 1, until the time interval of a memory step is "00" seconds. At that point, the memory will return to the step 1 output. The amplitude of each step will remain on for the programmed time interval of each step.

2. **CYCLE:** (One cycle output). Press the "**OUTPUT**" button to start. The meter output signal will follow the programmed steps, starting from step 1 and then will *lock* on the last output step (preceding the step with a programmed time interval of "00" seconds).

3. **STEP:** (Step output). In this mode the user manually selects each step in the program. Use the "▲" or "▼" button to select each step. The amplitude of the selected step will remain on until a new step is selected.



Amplitude

Figure-22 Selecting SCAN Output Manner

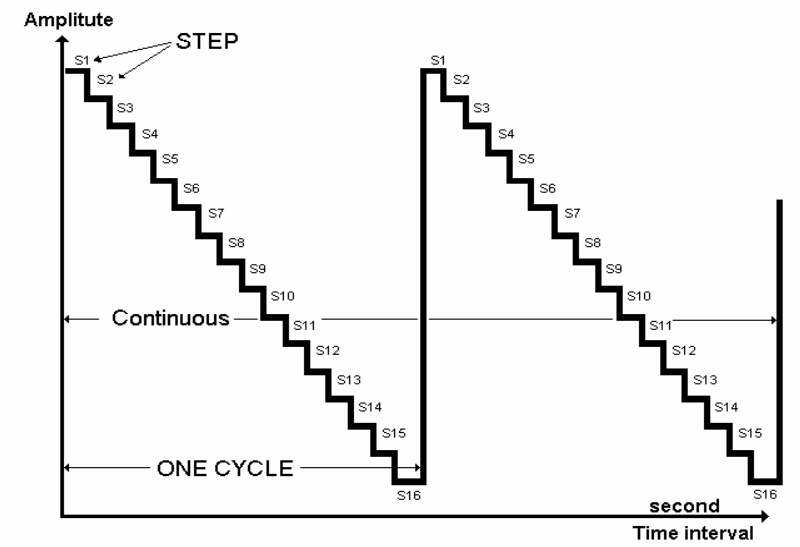


Figure-23 SCAN OUTPUT

Programming the SCAN output steps

Press and hold the "**MODE**" button for at least 1 second to enter the SCAN adjustment mode. There are 16 steps available and each can be programmed for time interval and output amplitude. The secondary display shows the amplitude. The left two digits of the primary display are used to indicate the step number. The last two digits of the primary display are used to indicate time interval. Use the "**MODE**" button to cycle through the **step, time interval** and **amplitude** adjustment fields. The screen will flash the digit that is to be adjusted. Normally, the step 1 adjustment will appear when the mode is entered. The time interval can be set from 0 to 99 seconds using the "▲" or "▼" buttons.

Press the "**OUTPUT**" button momentarily to save the setting.

Press and hold the " ▶ " button for at least 1 second to set the time and amplitude to zero.

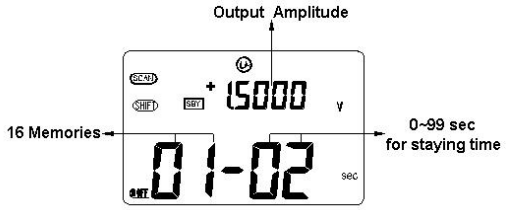


Figure-24 Memory Adjustment for SCAN Output

■ *AUTO RAMP OUTPUT*

1. Selecting the RAMP function

- Turn the rotary switch to the mA or V output position.
- Press "**SHIFT**" momentarily to shift the operation of the push buttons. Ensure that the SHIFT display icon appears on the display.
- For voltage outputs, press "**MODE**" momentarily to cycle through **±1.5V, ±15V, SCAN±1.5 V, SCAN ±15V, RAMP ±1.5 V** and **RAMP±15V** output modes. For current outputs, press "**MODE**" momentarily to cycle through **±25mA, SCAN ±25mA** and **RAMP±25mA** output modes.
- After setting the RAMP function, the display icon will switch on.

2. Table of default memory settings:

Mode		± 1.5000 V		± 15.000 V		± 25.000mA
Position	Amplitude	Resolution	Amplitude	Resolution	Ampl.	Res.
Start	-1.5000 V	015 steps	-15.000 V	015 steps	-25.000mA	025 steps
End	+1.5000 V	015 steps	+15.000 V	015 steps	+25.000mA	025 steps

3. Automatic RAMP output

After selecting the **RAMP** function, use the "◄" or "►" button to select Continuous or Cycle output. The secondary display will show **Cont** and **CYCLE,** respectively.

- **Cont:** Continuous output. Press the "**OUTPUT**" button to start. The meter's output signal will follow the programmed steps (0.33 seconds per step). For example, in the default settings Table above, the first slope interval = (end amplitude - start amplitude) divided by the resolution. Therefore, the interval is (1.5V+1.5V)/15steps= 0.2 V for **± 1.5000 V.** The interval of the secondary slope is (start amplitude - end amplitude) divided by the resolution. Therefore, the interval is (-1.5V-1.5V)/15steps= -0.2 V for **± 1.5000 V.**
- **CYCLE: (**One cycle output). Press the "**OUTPUT**" button to start. The meter's output signal will follow the programmed steps (0.33 seconds per step approx.) and then will lock on the last output step.

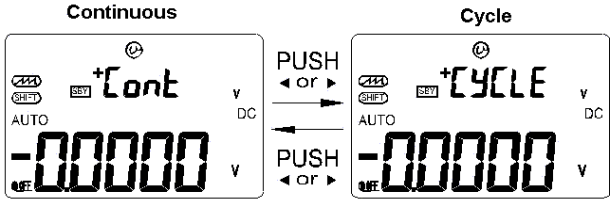


Figure-25 Selecting RAMP Output

4. Setting the RAMP parameters

Press and hold "**MODE**" for at least 1 second to enter the RAMP adjustment mode. The **RAMP** is a dual slope output, meaning that the user can adjust the resolution between start and end positions or end and start positions, and also the amplitude of start or end positions.

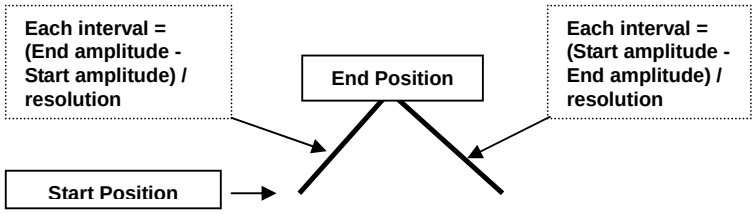

Each interval = (End amplitude - Start amplitude) / resolution
End Position
Each interval = (Start amplitude - End amplitude) / resolution
Start Position

Figure-26 RAMP OUTPUT

The secondary display shows the amplitude for the Start or End position. The left-most digit of the primary display indicates Start or End positions. The last three digits of the primary display are used to indicate interval. Push the "**MODE**" button momentarily to cycle through position, interval and amplitude adjustment. The screen will flash the digit to be adjusted. The resolution can be set from 1 to 999 by pressing the "▲" or "▼" buttons. Press the "**OUTPUT**" button momentarily to save a setting.

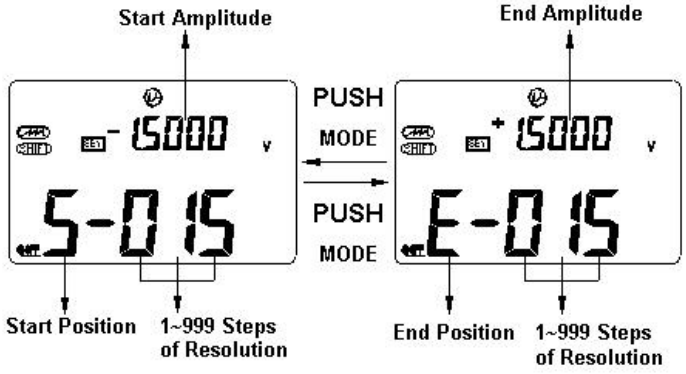


Figure-27 RAMP Output Programming

■ *SQUARE WAVE OUTPUT*

The Square wave output can be used to check and calibrate flow-meter display meters, counters, tachometers, oscilloscopes, frequency converters, frequency transmitters and other frequency input devices.

The Square wave output has four parameters: frequency, amplitude, duty cycle, and pulse width.

Select the square wave output function.

- Turn the rotary switch to the ⎍⎍⎍ output position.
- Press "**SHIFT**" momentarily to shift the operation of the push buttons. Ensure that the SHIFT display icon appears on the display.
- The default settings are **150 Hz, 50.00 %, 3.3333ms** and **+ 5V** for frequency, duty cycle pulse width and amplitude, respectively. See **Figure-28**.
- Press "**OUTPUT**" momentarily to send out the signal.

Twenty-eight (28) frequencies can be selected:

Frequency
0.5, 1, 2, 5, 10, 15, 20, 25, 30, 40, 50, 60, 75, 80, 100, 120, 150, 200, 240, 300, 400, 480, 600, 800, 1200, 1600, 2400, 4800 Hz

To select the square wave output frequency:

- Press "**SHIFT**" momentarily to shift the operation of the push buttons. The SHIFT display icon will switch on.
- Press "**MODE**" momentarily to select the frequency adjustment. The Hz display icon will switch on.
- Select the frequency using the "▲" or "▼" button.
- Press "**OUTPUT**" to send out the signal.

The duty cycle can be adjusted in 256 steps. Each step is 0.390625 % (the screen display resolution is 0.01 %).

To adjust the duty cycle:

- Press "**MODE**" momentarily to select the duty cycle adjustment. The % icon will switch on.
- Use the "▲" & "▼" buttons to adjust the duty cycle.

The Pulse width can be adjusted in 256 steps. Each step is 1/ (256*frequency) and depends on the frequency.

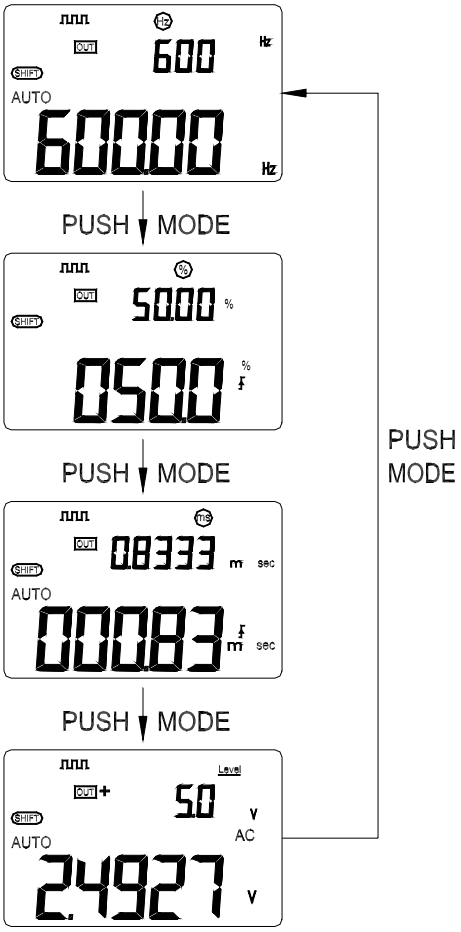
- Press "**MODE**" momentarily to select the pulse width adjustment. The MS sign will switch on.
- Use the "▲" & "▼" buttons to adjust the pulse width.

Select the amplitude (+ 5V, ± 5V, + 12V and ± 12V)

To select the square wave output.

- Press "**MODE**" momentarily to select the amplitude adjustment. The **Level** icon will switch on.
- Use the "▲" & "▼" buttons to select the amplitude.

Figure-28 Parameters selection for Square Wave output



Output Standby Modes and Overload Alerts

⚠ WARNING
Select the proper rotary switch function before connecting the test leads to a current loop or simulation points.

- ***OUTPUT/ STANDBY MODES***

The meter will automatically switch from the OUTPUT mode to the STANDBY mode when one of the following conditions exists:

1. Input signal is connected to the output terminals while the meter is trying to output a signal.
2. Excessive noise on the output terminals from an external power system or other source.
3. An overload condition has been detected during constant voltage or square wave outputs.
4. Weak battery or low battery condition.

Note: When the OUTPUT function is not to be used, set the slide switch to "M" (input only) position to save battery power.

- ***OVERLOAD ALERT FOR VOLTAGE MEASUREMENT***

⚠ WARNING
In case of an overload alert, remove the test leads from the measuring source.

This meter includes an overload alert for voltage measurements. The audible tone periodically beeps once the measurement voltage limit is exceeded (251.00V). For safety, please be aware of this alert.

☐ **Dynamic Recording**
☐ **Data Hold (Manual Trigger)**
☐ **Refresh Hold (Auto Trigger)**
☐ **Relative (Zero)**
☐ **1 ms Peak Hold**

■ *DYNAMIC RECORDING*

The dynamic recording mode can be used to capture POWER ON and POWER off surges, verify performance of power systems, automatically datalog in the field, and datalog in the laboratory.

The average reading feature is useful for smoothing out unstable or changing inputs, estimating the percentage of time a circuit is operated, or for verifying circuit performance.

The operational procedures are described below:

1. Press "**MAX • MIN**" for at least 1 second to enter the dynamic recording continuous mode (non data hold). The present value is stored in the maximum, minimum and average memories (the **MAX AVG MIN** display icons will switch ON).
2. Press and hold the button for at least 1 second to exit the recording mode.
3. Press the button momentarily to cycle through maximum, minimum, average and present readings. The **MAX**, **MIN**, **AVG** or **MAX AVG MIN** sign will switch on respectively to indicate which value is being displayed. See **Figure-29.**
4. The beeper sounds when a new maximum or minimum value is recorded.
5. If an overload is recorded the averaging function will stop. The average value becomes " **OL** "(overload).
6. In dynamic recording mode, the auto power off feature is disabled, and the "APO OFF" icon will switch off.
7. Selecting dynamic recording in the auto range mode will allow the meter to record the MAX, MIN or AVG values for various ranges
8. The recording speed of dynamic recording in manual range is about 0.067 seconds (approx.)
9. The average value is the true average of all measured values taken since the recording mode was entered

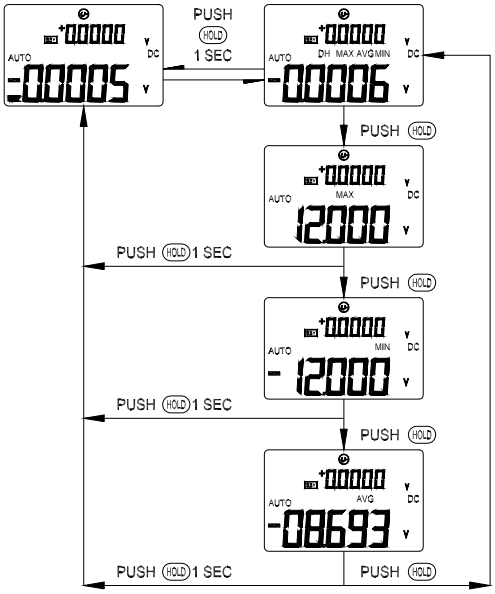


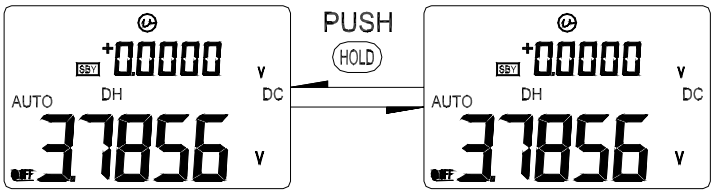
Figure-29 Display of Dynamic Recording

■ ***DATA HOLD (Manual Trigger)***

The data hold function allows operators to hold the displayed digital value. Press **HOLD** to freeze the displayed value and enter the manual trigger mode ("**DH**" will be displayed). Press the button again to trigger a new measurement thereby updating the display. The "**DH**" flashes before each new update. Press **HOLD** for at least one second to exit this mode.

Figure-30 Data Hold Operation

■ ***REFRESH HOLD (Auto Trigger)***



Refresh Hold automatically engages the DATA HOLD function when the present measurement value varies from the previous measurement value by a programmable amount; it also sounds a tone to alert the user that a new reading is being held.

Press "HOLD" to enter the Refresh Hold mode. The present value will be held and the "DH" icon will switch on. The meter will update the display with a new value only if a measurement is made that varies from the present measurement by a programmed amount; the "DH" icon will flash and an audible tone will sound when the display is updated with a new held reading.

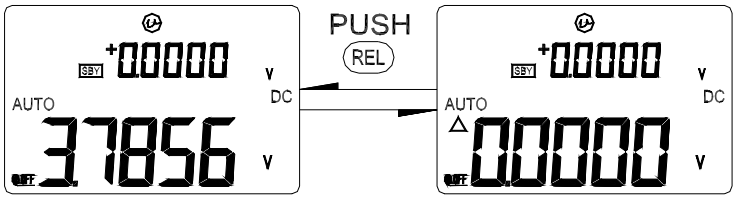
For voltage and current measurements, the held value will not be updated if the reading is below 500 counts. For resistance and diode measurements, the held value will not be updated if the reading is "**OL**" or in an open state.

■ *RELATIVE (ZERO) MODE*

The relative function subtracts a stored value from the present measurement and displays the result.

1. Press **REL** button momentarily to set the relative mode. This sets the display to zero and stores the displayed reading as a reference value, (the " Δ " display icon will switch on).
2. The relative mode can be used in the auto or the manual range mode, but can't be set when an overload has occurred.
3. Press **REL** again to exit the relative mode.
4. When the Ohm measurement mode is entered, the display will read a non-zero value due to the presence of test leads resistance. You can use the relative function to Zero-Adjust the display and null the test lead resistance.
5. For DC voltage measurements, the thermal effect will influence the accuracy. Use the relative function to zero the thermal effect. Short the test leads and press REL button momentarily.

Figure-31 Relative (Zero) Operation



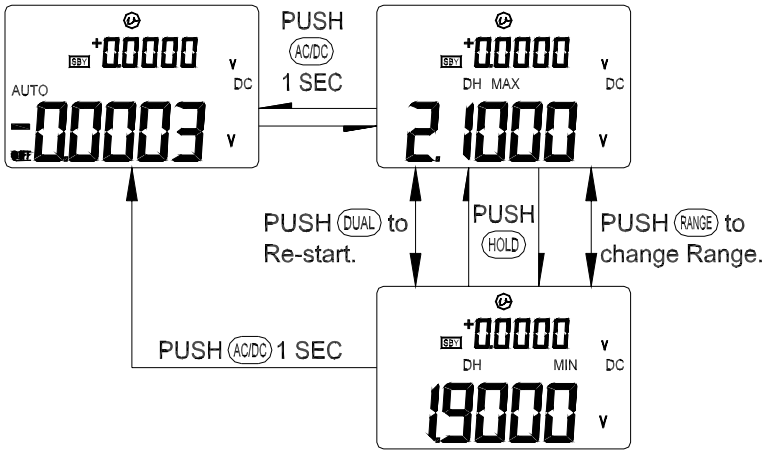
■ *1 ms Peak Hold*

This Meter can be used to analyze components such as power distribution transformers and power factor correction capacitors. Additional features allow the measurement of half-cycle peak voltage by using the 1 ms peak hold feature allowing the determination of the crest factor:

Crest factor = Peak value/True RMS value

1. Press the **BLUE** button for at least 1 second to toggle 1 ms peak hold mode ON/OFF.
2. Press **DH (MAX• MIN)** button momentarily to show peak + or peak - value after setting the peak mode. The display shows "**DH MAX**" to indicate the PEAK + and shows "**DH MIN**" to indicate the PEAK -. See **Figure-32**.
3. If the reading is " **OL**", then push the **RANGE** button momentarily to change the measuring range and re-start the PEAK measurement after setting the peak mode.
4. Press the **DUAL** button momentarily to re-start the 1 ms peak hold.

Figure-32 1 ms Peak Hold Display



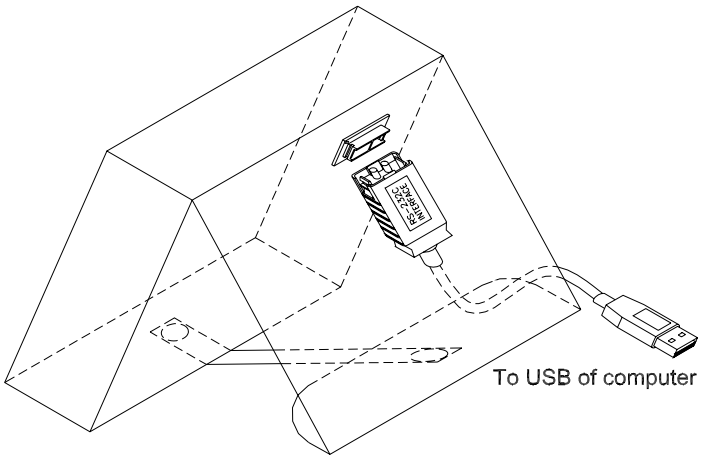
PC REMOTE COMMUNICATION

This instrument has bi-directional (full duplex) communication functionality. This feature allows the user to record and save data easily. The protocol format uses SCPI commands (Standard Commands for Programmable Instruments). All commands are ASCII characters (non-hexadecimal). The SCPI protocol is contained in the CMM-17 Protocol Manual on the supplied the CD-ROM.

Please refer to the following procedures for PC interface communication:

1. Setup the communication parameters for the meter and the personal computer. The meter's factory default settings are: 9600, n, 8, 1.
2. Be sure that the USB driver has been installed on your computer.
3. Connect the optical side of the cable to the communication port of the meter (text side of connector face up as shown in Figure-33.
4. The carrying case can be used as a stand as shown below in Figure-33.
5. Plug the USB end of the cable into the USB port of the personal computer. See the **Figure-33**.

Figure-33 Cable Connection for Communication



The frequency measurement capability of this meter helps detect the presence of harmonic currents in neutral conductors and determines whether these neutral currents are the result of unbalanced phases or non-linear loads.

■ ***Selection by Hz Button***

For Voltage or Current tests, press the **Hz** button momentarily to enter the Frequency measurement mode. Voltage or Current will be displayed on the secondary display, the frequency will display on the primary display. Press this button again to step through Frequency, Duty cycle and pulse width tests. This allows simultaneous monitoring of the present levels and frequency (or Duty Cycle, or pulse width).

Press and hold the **Hz** button for at least1 second to return to Voltage or Current measurement mode.

Function	Primary display	Secondary display
AC Voltage	Frequency (Hz)	ACV
	Duty Cycle (%)	ACV
	Pulse Width (ms)	ACV
DC Voltage	Frequency (Hz)	DCV
	Duty Cycle (%)	DCV
	Pulse Width (ms)	DCV
AC+DC Voltage	Frequency (Hz)	AC+DC V
	Duty Cycle (%)	AC+DC V
	Pulse Width (ms)	AC+DC V
AC Current	Frequency (Hz)	ACA
	Duty Cycle (%)	ACA
	Pulse Width (ms)	ACA
DC Current	Frequency (Hz)	DCA
	Duty Cycle (%)	DCA
	Pulse Width (ms)	DCA
AC+DC Current	Frequency (Hz)	AC+DC A
	Duty Cycle (%)	AC+DC A
	Pulse Width (ms)	AC+DC A
%(0-20 or 4-20)	Frequency (Hz)	%(0-20 or 4-20)
	Duty Cycle (%)	%(0-20 or 4-20)
	Pulse Width (ms)	%(0-20 or 4-20)

Figure-34 Combination display for AC Voltage Measurements

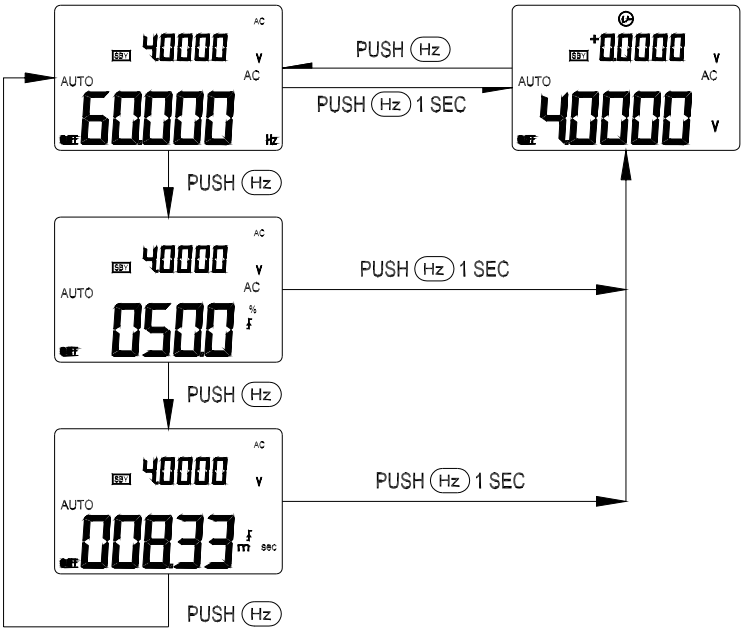
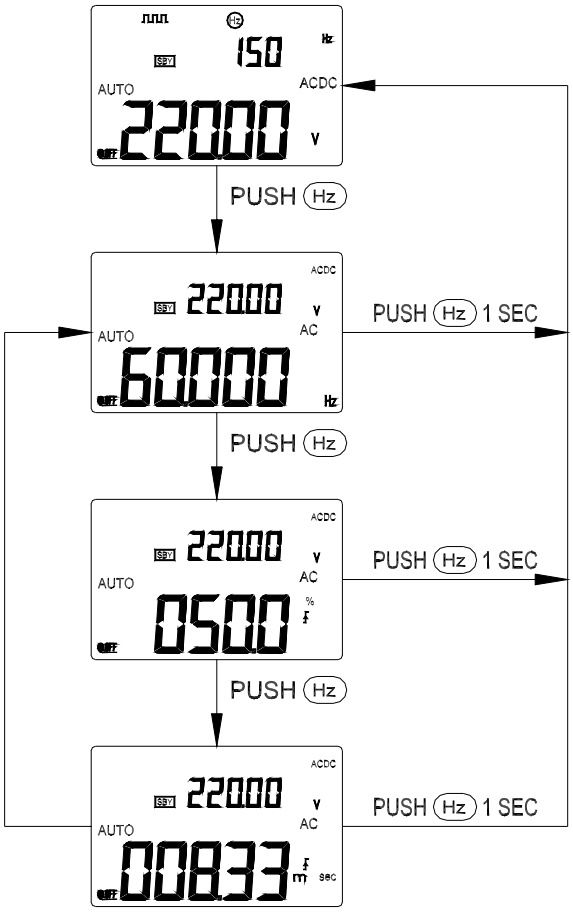


Figure-35 Combination display For AC+DC Voltage Measuring



■ ***DUAL button***

Another method for accessing combination displays is by pressing the DUAL button. The available dual displays are listed in the following table.

Function	Primary display	Secondary display
AC Voltage	ACV	Hz (AC coupling)
DC Voltage	DCV	Hz (DC coupling)
AC + DC Voltage	AC+DC V	Hz (AC coupling)
DC Current	DCA	Hz (DC coupling)
AC Current	ACA	Hz (AC coupling)
AC+DC Current	AC+DC A	Hz (AC coupling)
%(0-20 or 4-20)	%(0-20 or 4-20)	Hz (DC coupling)
Temperature	Celsius (°C)	Fahrenheit (°F)
	Fahrenheit (°F)	Celsius (°C)

Voltage Measurement

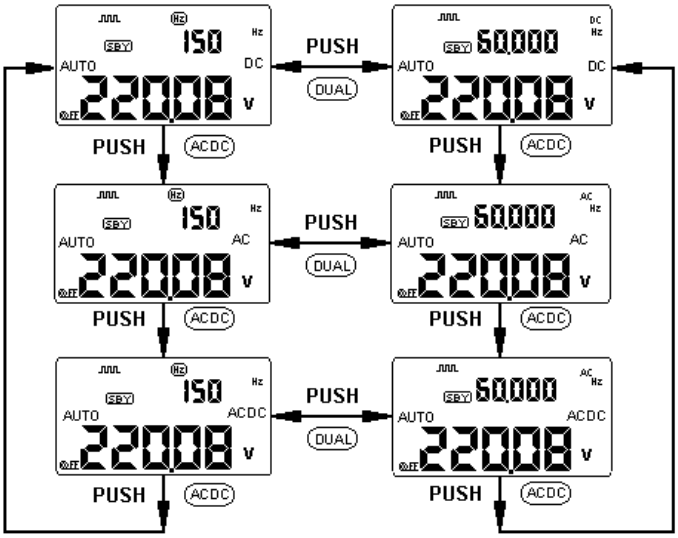


Figure-36 Using the DUAL & BLUE buttons for voltage measurements

CURRENT MEASUREMENTS

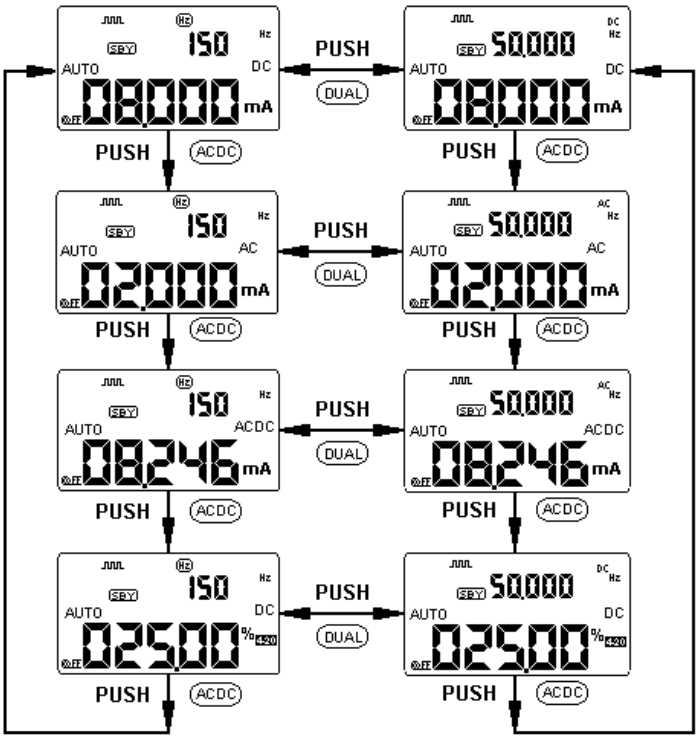
1. Press **AC/DC** momentarily to step through AC, DC+AC and DC tests.

Key operation	Primary display	Secondary display
Press AC/DC	AC mA	
Press AC/DC	AC+DC mA	
Press AC/DC	DC mA	
Press AC/DC	% for 4-20 or 0-20 mA	

2. Press **DUAL** momentarily to enter the multi-display mode.

Key operation	Primary display	Sec. display
Push Dual	DC mA (AC, AC+DC, % for 4-20 or 0-20mA)	Hz
Push Dual	DC mA (AC, AC+DC, % for 4-20 or 0-20mA)	

Figure-37 Using DUAL & BLUE buttons for Current Measurements



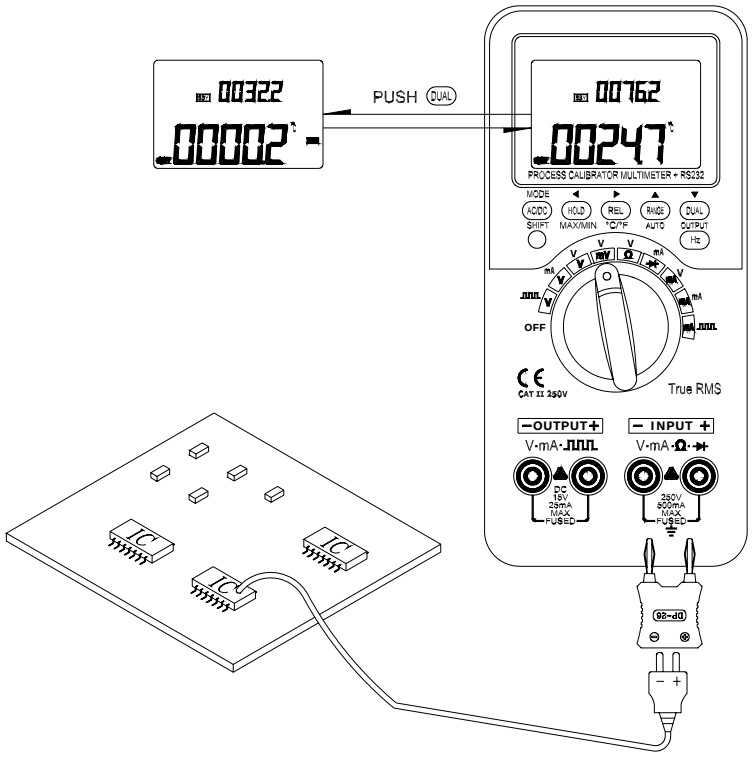
■ ***Temperature Measurement***

> ⚠ **CAUTION**
> **Do not bend the thermocouple leads sharply.**
> **Repeated bending can damage the leads**

The bead type thermocouple probe is suitable for making temperature measurements from -40°C (°F) to 204°C (399°F). Do not exceed these limits. Do not immerse the thermocouple in liquids. For best results, use a thermocouple probe designed for each application (i.e. an immersion probe for liquid or gel, an air probe for air measurements, etc.). Follow the measurement techniques as below:

1. Turn the slider switch to the “M” position to disable all output functions.
2. Turn the rotary switch to the " mV " range.
3. Press and hold the “**REL**” button for at least 1 second for temperature measurements.
4. Plug the adapter with thermocouple probe into the "**+**” and "**-**" input terminals.
5. Touch the thermocouple to the surface being measured.
6. Read the display.

Figure-38 Surface temperature measurement



SPECIFICATIONS

■ *GENERAL SPECIFICATIONS*

Display:

- The primary and secondary displays are 5-digit LCD displays with maximum reading of 51000 counts.
- Automatic polarity indication.

Functions:

- DCV, ACV, DCA, ACA, OHM, Diode check, Audible continuity, Temperature, Frequency, Duty cycle and Pulse Width tests.
- **AC+DC** true RMS measurement for both voltage and current.
- 1-ms peak hold for capturing glitches.
- % scale readout for 4-20mA and 0-20mA measurement
- High precision constant current and constant voltage outputs (Bipolar sink-source system).
- Memory: Up to 16 user-programmable locations for each range.
- Scan Output feature: One cycle or continuous cycling process outputs
- Ramp Output for linear process outputs
- Square wave output with adjustable duty cycle, pulse width and amplitude.
- EL Backlit display
- Min/Max/Average, Data Hold with Manual or Auto Trigger and Relative modes
- Bi-directional optical PC interface with SCPI commands

Measuring rate (Approx.):

- 3 times per second
- 1 time per second for frequency or duty cycle measurement. (>1Hz)
- 0.25 ~4 times per second for Pulse Width measurements. (>1Hz)

Low battery indicator:

The " " appears when the battery voltage drops below 8V (approx.).

Operating temperature: 32 to 122°F (0°C to 40 °C).

Storage temperature: -4 to 140°F (-20°C to 60°C) w/ BATTERY REMOVED

Relative Humidity (R.H.): maximum 80% R.H. for temperature up to 31°C decreasing linearly to 50% R.H. at 40°C

Temperature coefficient
INPUT: 0.15 * (specified accuracy) / °C (from 0°C to 18°C or 28°C to 40°C)
OUTPUT: ± (50ppm rdg + 0.5dgt)/ °C

Common Mode Rejection Ratio (CMRR):

>90 dB at DC, 50/60 Hz ±0.1% (1kΩ unbalanced)

Normal Mode Rejection Ratio (NMRR): > 60 dB at 50/60 Hz±0.1%

Power supply:

1. Rechargeable batteries 1.2V x 8 pieces (Ni-MH) (no cadmium, lead or mercury added).
2. The external switching adapter, AC100~250V/47~63Hz input and DC14 Volts/1A output.

Power Consumption: 5.0VA maximum
3.5VA typical (DC CC: 25mA, maximum load)
0.6VA typical (Meter only)

Battery life: 20 hours for meter only, 5 hours for meter/source. (The new Ni-MH 1300mA batteries have been fully charged.)

Charging time: 12 hours approx. at 50 to 86°F (10°C to 30 °C). If the battery has been fully discharged, a longer charging time may be experienced

Dimension: 2.1 (H) x 3.5 (W) x 7.5 (L)" [54 (H) x 90 (W) x 192 (L) mm]

Weight: 26 oz. (730 g) meter only; 60 oz. (1710 g) with standard accessories

Safety: Designed in compliance with EN61010-1 (IEC1010-1) for CAT-II 250V, Pollution Degree II Environment. EMC designed in compliance with EN61326-1.

■ *INPUT SPECIFICATIONS*

Accuracy is given as ±(% of reading + counts of least significant digit) at 23°C ± 5°C, with relative humidity Less than 80% R.H., and warm-up for 3 minutes.

DC mV/ VOLTAGE

Range	Resolution	Accuracy	Overload Protection
50mV	1μV	0.05% +50*	250V RMS
500mV	10μV	0.03% +5	
5V	0.1mV		
50V	1mV		
250V	10mV		

- Input Impedance: 10MΩ (nominal) from 5V range, 1 GΩ (nominal) for 50/500 mV.
- *The accuracy could be 0.05%+5, always use relative function to zero thermal effect (short test leads) before measuring the signal.

AC mV/ VOLTAGE (TRUE RMS: From 5% to 100% of range)

Range	Resolution	Accuracy		Overload Protection
		45Hz ~5k Hz	5kHz~20kHz	
50mV	1μV	0.7%+40	1.5%+40	250V RMS
500mV	10μV	0.7%+20	1.5%+20	
5V	0.1mV			
50V	1mV			
250V	10mV			

- Input Impedance: 1.1MΩ in parallel with <100pF(nominal) from 5V range, and 1 GΩ (nominal) for 50/500 mV.
- Crest factor<=3

AC+DC mV/ VOLTAGE (TRUE RMS: From 5% to 100% of range)

Range	Resolution	Accuracy		Overload Protection
		45Hz ~5kHz	5kHz~20kHz	
50mV	1μV	0.8%+70	1.6%+70	250V RMS
500mV	10μV	0.8%+25	1.6%+25	
5V	0.1mV			
50V	1mV			
250V	10mV			

- Input Impedance: 1.1MΩ in parallel with <100pF (nominal) from 5V range, and 1 GΩ (nominal) for 50/500 mV.
- Crest factor <=3

1 ms PEAK HOLD (Capturing changes >1 ms in duration)

Function	DC mV / DC Voltage	DC Current
Accuracy	2%+400 digits for all ranges	

DC CURRENT

Range	Resolution	Accuracy	Burden Voltage / Shunt	Overload Protection
50mA *	1μA	0.03% +5	0.06 V (1Ω)	250V, 630mA Quick acting fuse
500mA*	10μA	0.03% +5	0.6 V (1Ω)	

Note:
* Always use the relative function to zero the thermal effect with open test leads before measuring the signal. If the Relative function is not used, the accuracy will be 0.03%+25

AC CURRENT (TRUE RMS: From 5% to 100% of range)

Range	Resolution	Accuracy 45Hz ~ 2kHz	Burden Voltage / Shunt	Overload Protection
50 mA	1μA	0.6% +20	0.06 V (1Ω)	250V, 630mA Quick acting fuse
500 mA	10μA		0.6 V (1Ω)	

- Crest factor<=3

AC+DC CURRENT (TRUE RMS: From 5% to 100% of range.)

Range	Resolution	Accuracy 45Hz ~ 2kHz	Burden Voltage / Shunt	Overload Protection
50 mA	1μA	0.7% +25	0.06 V (1Ω)	250V, 630mA Quick acting fuse
500 mA	10μA		0.6 V (1Ω)	

- Crest factor<=3

RESISTANCE

Range	Resolution	Accuracy	Test current	Overload Protection
500Ω *	0.01 Ω	0.15% +8	0.45mA	250V RMS
5kΩ *	0.1 Ω	0.15% +5	0.45mA	
50kΩ	1 Ω		45μA	
500kΩ	10 Ω		4.5μA	
5MΩ	0.1 kΩ		450nA	
50MΩ**	1 kΩ	1% +8	45nA	

- Maximum open voltage: < +4.8V
- Continuity: Built-in buzzer sounds when resistance is less than 10.00Ω
- * The accuracy for the 500Ω and 5kΩ range is specified after the Relative function is employed, which is used to subtract the test lead resistance and the thermal effects from the readings.
- ** For the range of 50MΩ, the RH is specified for < 60%.

DIODE CHECK / AUDIBLE CONTINUITY TEST

Range	Resolution	Accuracy	Test Current	Open Voltage
Diode	0.1 mV	0.05% +5	Approx. 0.45mA	<+4.8V DC

- Overload protection: 250V RMS
- Built-in buzzer sounds when reading is below 50mV approx

K - TYPE TEMPERATURE TEST

RANGE	Resolution	Accuracy	Overload Protection
-40°C ~ 1372°C	0.1°C	0.3% +3°C	250V RMS
-40°F ~ 2502°F	0.1°F	0.3% +6°F	

- The accuracy is defined for meter operation only and excludes the tolerance of the thermocouple probe.

FREQUENCY

Range	Resolution	Accuracy	Min. Input Freq.
100Hz	0.001 Hz	0.02%+3	1Hz
1kHz	0.01Hz		
10kHz	0.1Hz		
100kHz	1 Hz		
200kHz	10Hz		

- Overload protection: 250V RMS

Sensitivity for Voltage Measurement

FREQUENCY SENSITIVITY AND TRIGGER LEVEL				
INPUT RANGE	MINIMUM SENSITIVITY (RMS SINEWAVE)		Trigger Level for DC coupling	
(Maximum input for specified accuracy = 10 x Range or 250V)	1 Hz-100 kHz	>100 kHz	< 20 kHz	20 kHz ~ 200 kHz
50 mV	15mV	25mV	20mV	30mV
500 mV	35mV	50mV	60mV	80 mV
5V	0.3V	0.5V	0.6V	0.8V
50V	3V	5V	6V	8V
250V	30V	NO SPEC.	60V	NO SPEC.

The accuracy for duty cycle and pulse width is based on a 5V square wave input in the DC 5V range.

DUTY CYCLE:

Range: 0.1% to 99.9 % for DC coupling, 5% to 95% for AC coupling
Accuracy: Within (0.3% per kHz + 0.3%) of full scale

PULSE WIDTH:

Range: 0.1 ms to 1999 ms
Accuracy: 0.2%+3
Pulse width must be greater than 10µs; its range is determined by the frequency of the signal.

- For Maximum V-Hz input and input Impedance specifications please refer to the AC Voltage measurement section and the specifications chart.

Sensitivity for Current Measurement

Input Range	Minimum Sensitivity (RMS Sine-wave)
	30Hz~20kHz
50mA	2.5mA
500mA	25mA

- Maximum input, please refer to AC Current measurement section

■ *OUTPUT SPECIFICATIONS*

Accuracy is given as ± (% of output + counts of least significant digit) at 23°C ± 5°C, with relative humidity Less than 80% R.H.

CONSTANT VOLTAGE (CV)

Range	Resolution	Accuracy	Minimum * Output Current
± 1.5000V	0.1 mV	0.03% +3	25mA or above
±15.000V	1 mV		

NOTE:
1. *Loading coefficient: **0.012mV/ mA** for 1.5V output.
2. Maximum protection input voltage: 30 V DC

CONSTANT CURRENT (CC)

Range	Resolution	Accuracy	Minimum * Output Voltage
± 25.000 mA	1 μA	0.03%+5	12V or above

NOTE:
1. *Loading coefficient: **1μA/ V**, the minimum output voltage is based on 20mA into 600Ω.
2. Maximum protection input voltage: 30 V DC
3. If the loop has 24V power at 20 mA use the special 1200Ω yellow lead.

SQUARE WAVE OUTPUT

OUTPUT	Range	Resolution	Accuracy
Frequency	0.5, 1, 2, 5, 10, 15, 20, 25, 30, 40, 50, 60, 75, 80, 100, 120, 150, 200, 240, 300, 400, 480, 600, 800, 1200, 1600, 2400, 4800 Hz	0.01Hz	0.005 % +1
Duty cycle*	0.39% ~ 99.60 %	0.390625%	0.01 % +0.2%
Pulse width*	1 / Frequency	Range/256	0.01 % +0.3ms
Amplitude	5V, ± 5V, 12V, ± 12V	0.1V	2 % + 0.2V

NOTES:
1. The pulse width must be greater than ± 50 μs or the accuracy specification may increase
2. Input protection: 30 V DC

⚠ WARNING
To avoid electrical shock, do not perform any service unless you are qualified to do so.

■ *SERVICE*

If the instrument fails to operate, check the batteries and the test leads and replace them if necessary. If the instrument still fails to operate, double check the operating procedure described in this instruction manual. When servicing, use specified replacement parts only. The following table identifies basic problems:

Malfunction	**To check**
No LCD indication when power is turned on.	Check that the slider switch is set to the M or M/S position. Check battery and charge if necessary.
No beeper tone	Check the setup mode. The beeper may be set to OFF. Select a frequency in the setup mode.
Failed on current measurement	Check Fuse 1
No output signal. Press OUTPUT button, OUT displays briefly and then reverts to SBY. The OUT icon appears but there's no output.	Low battery. Check that the slider switch is set to M/S. Check that the external Load is within spec. For 24V loops use special yellow test lead for mA simulation. Check Fuse 2.
No charging indication	Set the slider switch to the Charge position. Check that the external adaptor is DC 14V and plugged into the DC jack completely. Line power voltage (100V~250V AC 47Hz~ 63Hz) and power cord
Failed on Remote control	The optical side of the cable connects to the meter (text side of connector faces up). Check the baud rate, parity, Data bit, Stop bit (default is 9600, n, 8, 1) Check that the driver is installed for USB-RS232

■ *BATTERY CHARGING*

> **⚠ WARNING**
> **Never discharge battery or short a battery. Never mix different types of batteries or reverse polarity. Always check the battery type before charging the battery.**

The meter is powered by 4 sets of rechargeable batteries. When the "[+ −]" sign is displayed and flashing, the batteries need charging. To charge the battery:

1. Turn the meter off and disconnect the test leads from external equipment.
2. Plug the DC adapter into the jack at left side.
3. Turn slide switch to the charge position.
4. The **RED** lamp indicates the battery is charging.
5. Remove the DC adapter or turn the slide switch to "**M**" position when the **GREEN** lamp is indicated, the battery has been fully charged.

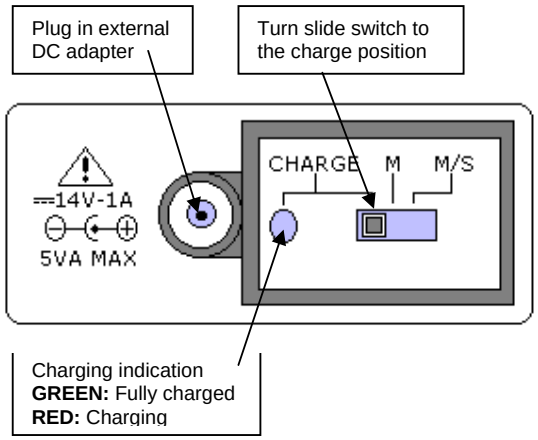


Figure-62 Charge Battery

■ *BATTERY REPLACEMENT*

⚠ WARNING

CONTAINS NICKEL-METAL HYDRIDE BATTERY, MUST BE RECYCLED OR DISPOSED OF PROPERLY.

Ni-MH

Remove all test leads and external adaptor before opening the case.

1. Loosen screw on the cover of battery compartment.
2. Slide the cover to the left, then pull up and remove the cover.

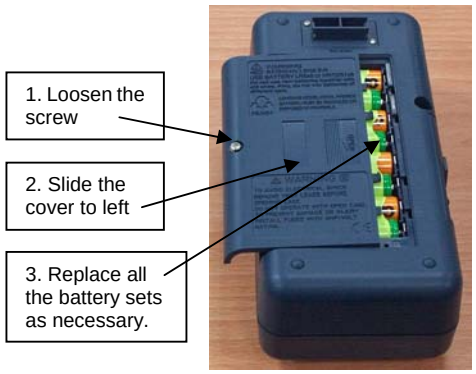


Figure-63 Battery replacement

■ *FUSE REPLACEMENT*

Use the following procedures to replace the fuses:

1. Use the rotary switch to turn the meter off.
2. Disconnect the test leads from external equipment. Be sure the adaptor has been removed.
3. Remove the battery compartment cover and remove the batteries.
4. Loosen the 3 screws on the bottom of the housing and remove the cover.
5. Lift the circuit board as shown in **Figure 64**.
6. Remove the defective fuse by gently prying one end of the fuse loose and sliding the fuse out of the fuse bracket.
7. Install a new fuse of the same size and rating. Make sure the new fuse is centered in the fuse holder.
8. Ensure that the rotary switch and the circuit board switch remain in the **OFF** position.
9. Fasten the circuit board and the bottom cover respectively.
10. Refer to the fuse specifications below:

POSITION	RATING	SIZE	Type
Fuse1	630mA/ 250V	5x20 mm	Quick acting
Fuse2	63mA/ 250V	5x20 mm	Time-lag acting

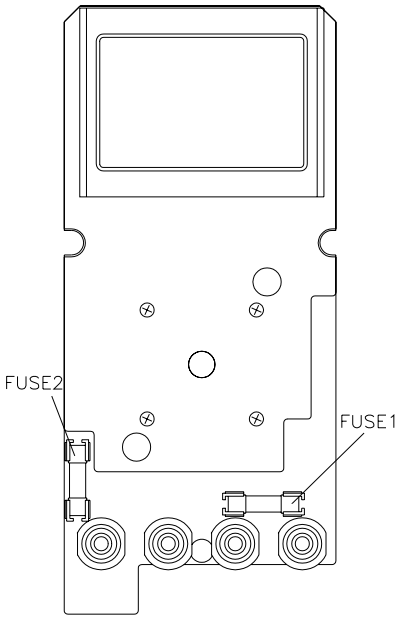


Figure-64 Fuse replacement

■ *CLEANING*

⚠ WARNING
To avoid electrical shock or damage to the meter, do not allow water inside the case.

To clean the instrument, use a soft cloth dampened in a solution of mild detergent and water. Do not spray cleaner directly onto the instrument, since it may leak into the cabinet and cause damage. Do not use chemicals containing benzine, benzene, toluene, xylene, acetone or similar solvents. After cleaning, make sure the instrument is dried completely before using.